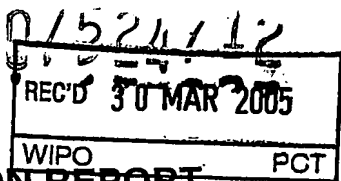


INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 44 426 K	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/EP 03/09460	International filing date (day/month/year) 27.08.2003	Priority date (day/month/year) 29.08.2002
International Patent Classification (IPC) or both national classification and IPC G06F17/18		
Applicant SCHMIDT + CLEMENS GMBH & CO. KG et al.		


- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 11 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 16 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 29.03.2004	Date of completion of this report 24.03.2005
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Barba, M Telephone No. +49 89 2399-2732



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10/524/12

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-28 as originally filed

Claims, Numbers

1-10 received on 15.04.2004 with letter of 14.04.2004

Drawings, Sheets

1-4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 3, 4, 7

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 3, 4, 7 are so unclear that no meaningful opinion could be formed (*specify*):

see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos.

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the Standard.

☐ the computer readable form has not been furnished or does not comply with the Standard.

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:

☐ restricted the claims.

☐ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

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☐ complied with.

☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

☐ all parts.

☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1,2, 5, 6, 8-10
	No: Claims	
Inventive step (IS)	Yes: Claims	1, 2, 5, 6, 8-10
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1, 2, 5, 6, 8-10
	No: Claims	

2. Citations and explanations

see separate sheet

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Reference is made to the following document:

D1: F.L. GREITZER ET AL: "Development of a Framework for Predicting Life of Mechanical Systems: Life Extension Analysis and Prognostics (LEAP)"
INTERNATIONAL SOCIETY OF LOGISTIS 1999 SYMPOSIUM, 30 August
1999 (1999-08-30), - 2 September 1999 (1999-09-02) pages 1-7, XP002226152
LAS VEGAS, NEVADA, USA

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

- 1 When considering the extent of the clarity objections under the provisions of Article 6 PCT, concerning present claims 3, 4 and 7 (see Item VIII below) this International Preliminary Examining Authority does not consider possible to carry out a full substantive examination with respect to the requirements of novelty, inventive step and industrial applicability as set out in Article 33 (2), (3) and (4) PCT for what concerns independent claims 3, 4 and 7.
Consequently, this International Preliminary Examining Authority shall not go into the questions referred to in Article 33 (1) PCT (Article 34 (4) (a) (ii) PCT) in respect of the subject matter of dependent claims 3, 4 and 7.

Re Item IV

Lack of unity of invention

- 1.1 The International Searching Authority raised an objection of lack of Unity under the provisions of Rule 13.1 PCT with regard the set of claims as originally filed finding two different inventions (see reasoning in Box II of the International Search Report). After payment under protest of the searching fees for an additional search, a complete search report for the claims of both inventions has been issued on 28.01.2004 by the International Searching Authority.
The applicant filed with his letter of 14.04.2004 and received on 15.04.2004 an

amended version of the claims, whereby, in the view of this International Examining Authority the previous objection of lack of unity according to Rule 1.1 PCT was remedied by the applicant. Consequently the objection of lack of unity according to Rule 13.1 PCT raised by the International Searching Authority is considered not anymore applicable to the present set of claims.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

- 2 The present application is directed, inter alia, to a method for modelling the life expectance of a piece of equipment in an industrial plant, specially in a furnace, providing reliable prediction of life expectance of such piece.
The algorithm used by the method of the application is based on a multi regression analysis, whereby the influence of a plurality of influencing parameters, relevant to the life of said piece, is better taken into account. In fact the use of multiple regression analysis gives the advantage that the value to predict is not determined based only on its dependancy on a single parameter, but on a plurality of parameters, therefore resulting in a better and more accurate prediction of he expected life. The parameters to be used are selected based on their correlation and significance in order to avoid using parameters non significant, giving therefore false indications because of higher variance.
For these reasons, according to the method of the application, in order to identify the most accurate model, only certain equations are studied according on preselected combinations of variables.
The selection of the most suitable variables is carried out by determining significance values and correlation values.
- 2.1 Document D1, that provisionally is considered as the closest prior art, discloses (see from page 1 line 24 to page 3 line 24; from page 4 line 5 to page 6 line 13) a method to compute MTBF in a mechanical system by using multivariate regression analysis and Bayesian regression.

The below-mentioned lack of clarity notwithstanding, it appears that the method known from D1 differs from the method of present claim 1 in that the selection of the influencing parameters and their representing variables is carried out without taking into account their correlation and significance.

Therefore the method known from D1 has the problem that in order to carry out the regression analysis no previous selection of the best variables combination is performed and consequently non significant parameters can be used and false indication due to higher variance may be produced as results of the regression analysis for what concerns the MTBF of the mechanical system.

- 2.2 The method of present independent claim 1 solves this problem of the prior art by selecting the parameters to be used according to the algorithm of claim 1 whereby parameters are selected based on their correlation and significance.

The subject matter of present independent claim 1 is therefore new and involves an inventive step and as such it meets the requirements of Article 33 (2) and (3) PCT.

- 3 The below-mentioned lack of clarity notwithstanding, it appears that the method of independent claim 2 is also new and inventive and as such it meets the requirements of Article 33 (2) and (3) PCT for the same reasons, mutatis mutandis, as above mentioned in paragraph 2 to 2.1 of this International Preliminary Examination Report. Moreover, with regard to the subject matter of present independent claim 2 the following is also noted.

The method of claim 2 refers to a situation wherein each influencing parameter has a highly level of significance and a low correlation; therefore, according to the description in this case it is advantageous to start with an equation generated by multiple regression analysis that is based on all influencing parameters and to exclude certain parameters from this equation according to specific rules. Thus, in the view of this International Examining Authority the subject matter of present claim 2 relates to an alternative solution to the same problem as above mentioned with regard to present independent claim 1, where it is not appropriate to cover these alternatives by a single independent claim.

- 4 Furthermore, the below-mentioned lack of clarity notwithstanding, the subject-matter

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of claim 5 and claim 6 is also new and inventive and therefore it satisfies the requirements of Article 33 (2) and (3) PCT for the same reasons as above mentioned in paragraph 2 to 2.1 of this International Preliminary Examination Report.

- 4.1 Insofar it is possible to understand from the description (see Item VIII below) it appears that independent claims 8 and 9 are the apparatus claims corresponding to method claims 1 and 2 respectively. Thus they also meet the requirements of novelty and inventive step as set out in Article 33 (2) and (3) PCT, the reasons therefore being the same, mutatis mutandis, as above mentioned in paragraph 2 to 3 of this International Preliminary Examination Report.
- 4.2 With regard to the assessment of the present claims 1, 2, 5, 6, 8, 9 and 10 on the question whether they are industrially applicable, the following is stated.
The subject matter of present claims 1, 2, 5, 6, 8, 9 and 10 relates to a method for modelling the life expectance of a piece of equipment in an industrial plant, specially in a furnace, providing reliable prediction of life expectance of such piece; therefore it fulfills the requirements of industrial applicability as set out in Article 33 (4) PCT.

Re Item VII

Certain defects in the international application

- 4.3 Present independent claim 5 comprises all the features of independent claim 1 and is therefore not appropriately formulated as a claim dependent on the latter (Rule 6.4 PCT).
- 4.4 Present independent claim 6 comprises all the features of independent claim 2 and is therefore not appropriately formulated as a claim dependent on the latter (Rule 6.4 PCT).
- 4.5 The features of present set of claims is not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

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- 4.6 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor are these documents identified therein.
- 4.7 Furthermore, at page 10, lines 6 to 10, the description contains general statements that the extent of protection may be expanded in some vague and not precisely defined way. Such general statements shall be deleted as contrary to Article 6 PCT, cf. also PCT Preliminary Examination Guidelines, C-III, 4.3a.

Re Item VIII

Certain observations on the international application

- 5 Present independent claim 1 is not clear and therefore it does not meet the requirements of Article 6 PCT for the following reasons.
- 5.1 The wording "whereby a formula ... contains the following steps" used in claim 1 is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.
- 6 Present independent claim 2 is not clear and therefore it does not meet the requirements of Article 6 PCT for the same reasons as above mentioned, mutatis mutandis, in paragraph 5.1 of this International Preliminary Examination Report.
- 7 Dependent claim 3 is unclear and it does not meet the requirements of Article 6 PCT for the following reasons.
The wording "at least" and "the according life" used in claim 3 are vague and unclear and leave the reader in doubt as to the meaning of the technical features to which they refer, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.

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- 7.1 The same reasoning is also valid for the subject matter of dependent claim 4 (Article 6 PCT)
- 8 Present independent claim 5 is not clear and therefore it does not meet the requirements of Article 6 PCT for the following reasons.
- 8.1 The wording "the system uses a formula" used in claim 5 is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.
- 9 Present independent claim 6 is not clear and therefore it does not meet the requirements of Article 6 PCT for the same reasons as above mentioned, mutatis mutandis, in paragraph 8.1 of this International Preliminary Examination Report.
- 10 Dependent claim 7 is vague and unclear because its present wording, when considered as a whole, is vague and unclear and it creates in the skilled reader a state of confusion as to the assessment of the extent of the subject matter intended to be claimed (Article 6 PCT). In particular the wording "which failed ... influence" does not appear to have a clear and specific technical meaning.
- 11 Present independent claim 8 is not clear and therefore it does not meet the requirements of Article 6 PCT for the following reasons.
- 11.1 Some of the features in the apparatus claim 8 relate to a method of using the apparatus rather than clearly defining the apparatus in terms of its technical features. The intended limitations are therefore not clear from this claim, contrary to the requirements of Article 6 PCT.
- 11.2 The wording "a formula ... contains the following steps" used in claim 8 is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to

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which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.

- 11.3 In order to overcome this objection a formulation in terms of functional means should be used, or alternatively a formulation of the type "Data processing system comprising means adapted to carry out each of the steps of method claims 1 to ...".
- 12 The same comments (see paragraph 11.1 and 11.2 of this International Preliminary Examination Report) are also valid, *mutatis mutandis* for the subject matter of independent claim 9 (Article 6 PCT).
- 13 Dependent claim 10 is not clear and as such it does not meet the requirements of Article 6 PCT for the same reasons, *mutatis mutandis*, as above mentioned in paragraph 11.1 of this International Preliminary Examination Report and for the following additional reason.
- 13.1 Claim 10 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim attempts to define the subject-matter in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result.

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ART 34 AMDT

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Patent Claims:

1. Method for determining the probable life of a piece of equipment in an industrial plant which uses multiple regression analysis to express an expected life in terms of variables relevant for the life.
2. Method according to claim 1, consisting at least of the following steps:
 - identifying the variables relevant for the life of the piece of equipment,
 - collecting data for the variables relevant for the life of the piece of equipment and the according life,
 - performing a multiple regression analysis using the collected data to determine for the variables factors of influence on the life,
 - generating a formula of the type used in multiple regression analysis, expressing the expected life in terms of the variables using the factors of influence found.
3. Method according to claim 2, wherein the data is taken from a control system and/or the operational history of an industrial plant and/or the design of the industrial plant.
4. Method according to one of the claims 1 to 3, whereby a formula to model the expected life from a value-database correlating individual values for the life with other individual values of one or more influencing-parameters, contains the following steps:

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ART 34 AMDT

- 5
- a) determining a start value as first influencing-parameter,
- b) generating a current equation based on the start value and thereby entering the start value as equation-parameter into the equation,
- 10
- c) determining a significance value and a correlation value for each influencing-parameter with respect to the equation-parameter(s),
- d) selecting as new equation-parameter the influencing-parameter with the highest significance and the lowest correlation that is not an equation-parameter and has according to a parameter-database not been used as equation-parameter in combination with the equation-parameters of the current equation,
- 15
- e) replacing the current equation with a new current equation by generating the new current equation based on the equation-parameters now including the new equation-parameter by means of multiple regression analysis based on the values of the value-database,
- 20
- f) recording in parameter-database the combination of influencing-parameters already used as equation-parameters and the order of introducing the equation-parameters into the current equation,
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- g) calculating the performance of the current equation and recording this performance with reference to the equation-parameters in the current equation in a performance-database
- h) repeating the steps c) to g) until for none of the influencing-param-

5 ters that are not equation-parameters the significance is higher than a
predetermined value while at the same time the correlation is lower
than a predetermined value or either the significance of an equation-
parameter has become lower than a predetermined value or the corre-
lation of an equation-parameter becomes higher than a predetermined
value,

10 i) excluding the influencing-parameter that according to the parameter-
database was last selected as new equation-parameter and replacing
the current equation with a new current equation by generating the
new current equation based on the equation-parameters that remain
after exclusion of the last selected influencing-parameter by means of
multiple regression analysis based on the values of the value-
database,

15 j) repeating the steps c) to i) until the influencing-parameter to be
excluded is the start value,

20 k) selecting from the database the set of equation-parameters which
provided the best performance and generating a final equation by use
of multiple regression analysis based on these influencing-parameters
and their individual values in the value-database.

25 5. Method according to one of the claims 1 to 3, whereby a formula to
model the expected life from a value-database correlating individual
values for the life with other individual values of one or more influenc-
ing-parameters, contains the following steps:

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ART 34 AND*

a) generating a current equation based on the all influencing-parameters and as further influencing-parameter a determined start-value as equation-parameters by means of multiple regression analysis based on the values of the value-database,

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b) determining a significance value and a correlation value for each influencing-parameter with respect to the equation-parameters,

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c) selecting as new unnecessary influencing-parameter the equation-parameter with the lowest significance and the highest correlation that is according to a parameter-database not an unnecessary influencing-parameter and whose removal as equation-parameter does according to a parameter-database not lead to a combination of equation-parameters that according to the parameter-database has previously been used ,

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d) replacing the current equation with a new current equation by generating the new current equation based on the set of equation-parameters from which the new unnecessary influencing-parameter has been removed by means of multiple regression analysis based on the values of the value-database,

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e) recording in the parameter-database the combinations of parameters used and the order of removal of unnecessary influencing-parameters from the current equation,

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f) calculating the performance of the current equation and recording this performance with reference to the equation-parameters in the

current equation in a performance-database,

g) repeating the steps b) to f) until for none of the influencing-parameters that are equation-parameters either the significance is lower than a predetermined value or the correlation is higher than a predetermined value or for one of the unnecessary-parameters the significance has become higher than a predetermined value while at the same time the correlation has become lower than a predetermined value.

h) re-introducing the influencing-parameter that according to the parameter-database was last removed as new unnecessary influencing-parameter,

i) repeating the steps b) to h) until either the influencing-parameter to be excluded is the start value or until no equation-parameter that has a significance that is lower than a predetermined value or a correlation that is higher than a predetermined value can be excluded without leading to a combination of equation-parameters that has already been sampled,

j) selecting from the database the set of equation-parameters which provided the best performance and generating a final equation by use of multiple regression analysis based on these influencing-parameters and their individual values in the value-database.

6. Method for performing maintenance on an industrial plant, whereby operational data and/or design data of the industrial plant is fed into a

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system, which generates at least one value for an expected life of one piece of equipment of the industrial plant and whereby the piece of equipment is exchanged when the actual life equates to the predicted life or a value derived from the predicted life, whereby

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- the system uses a formula of the type used in multiple regression analysis, expressing the expected life in terms of variables relevant for the life using factors of influence and
- the factors of influence are found by performing a multiple regression analysis using data collected for variables relevant for the life and the according life.

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7. Method according to claim 6, characterised in that collected data for variables relevant for the life from a piece of equipment of the same type which failed pre-predicted is used to modify the factors of influence.

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8. Method according to claim 6 or 7, characterised in that a method according to one of the claims 1 to 5 is used.

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9. Maintenance-System consisting of a calculating unit, a storage unit, an input unit characterised in that

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- a formula of the type used in multiple regression analysis that expresses an expected life of a piece of equipment in terms of influencing-parameters relevant for the life and factors of influence is stored in the storage unit,

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ART 34 ADP
- the calculating unit is adapted to read the formula from the storage unit,
 - the calculating unit is adapted to apply the formula to values for the variables received from the input unit and/or read from the storage unit so as to generate a value for an expected life.

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10. Maintenance-System according to claim 9, characterised in that the calculating unit is adapted to compare the value for an expected life with a value for the actual life generated from data received from the input unit and/or read from the storage unit to generate a value for remaining life.

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11. Use of the method according to one of the claims 1 to 5, of the method according to claim 6 to 8 and/or of the maintenance-system according to claim 9 or 10 for operating an ethylene production plant.

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